AGRICULTURAL Research

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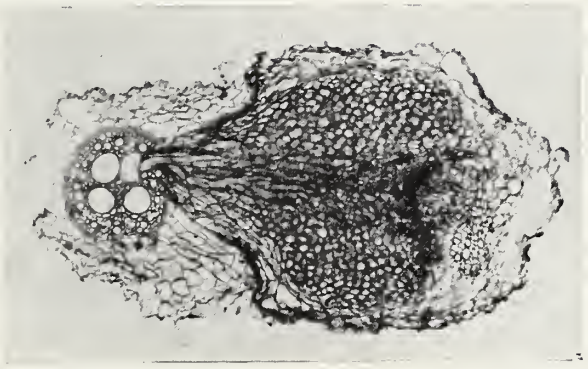

AGRICULTURAL
Research

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Chemicals

Twenty years ago industry produced some 50 basic chemicals for use on our farms. Now this number exceeds 200.

Of the 1959 volume (about 50 million tons), some 90 percent would not have been available at the start of World War II. Pesticides cost farmers about $29 million annually in the 1930's; now the cost is near $260 million.

The upward trend in use of effective chemicals is going to continue for obvious reasons. Consumers have come to expect products with quality and sanitation standards never dreamed of in past generations. Chemicals offer the only economical means of maintaining this quality.

Returns and rewards are great when chemicals are used properly. Improper use of some chemicals can be dangerous. Responsibility for either registering or policing the use of agricultural chemicals cannot be taken lightly. Questions of safety, proper use, residues, and others need attention.

To find answers, we must, of course, make wise use of information now at hand. We must be alert to future developments. Along with industry, we must continue searching for materials that can be formulated into effective farm chemicals. We must press for safer chemicals—seeking the widest margin of safety to consumers and national resources.

In dealing with current problems involving safe use of chemicals on agricultural commodities, we must adhere to the rule of reason. We cannot legislate our way out of the residue problem, or safety problems. We must rely on the best scientific judgment available to determine under what circumstances chemicals may be used to public advantage.

Few of the hundreds of potential new farm chemicals studied every year eventually reach the market. Many that do a superior job of killing insects, disease organisms, or weeds are rejected because they do not meet exacting safety standards.

Chemicals are essential production tools. If we are to continue providing food, in the variety and quality we want, we have no present alternative to the use of chemicals.

Surely, we are competent to use them to great advantage without harm to anyone.

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

For Fruit Trees...

A BETTER PRUNING MACHINE

Experimental device makes a tedious job more pleasant, costs less to operate

■ A new State-USDA fruit tree hedger has shown its usefulness in pruning—normally an unpleasant, expensive, and time-consuming job.

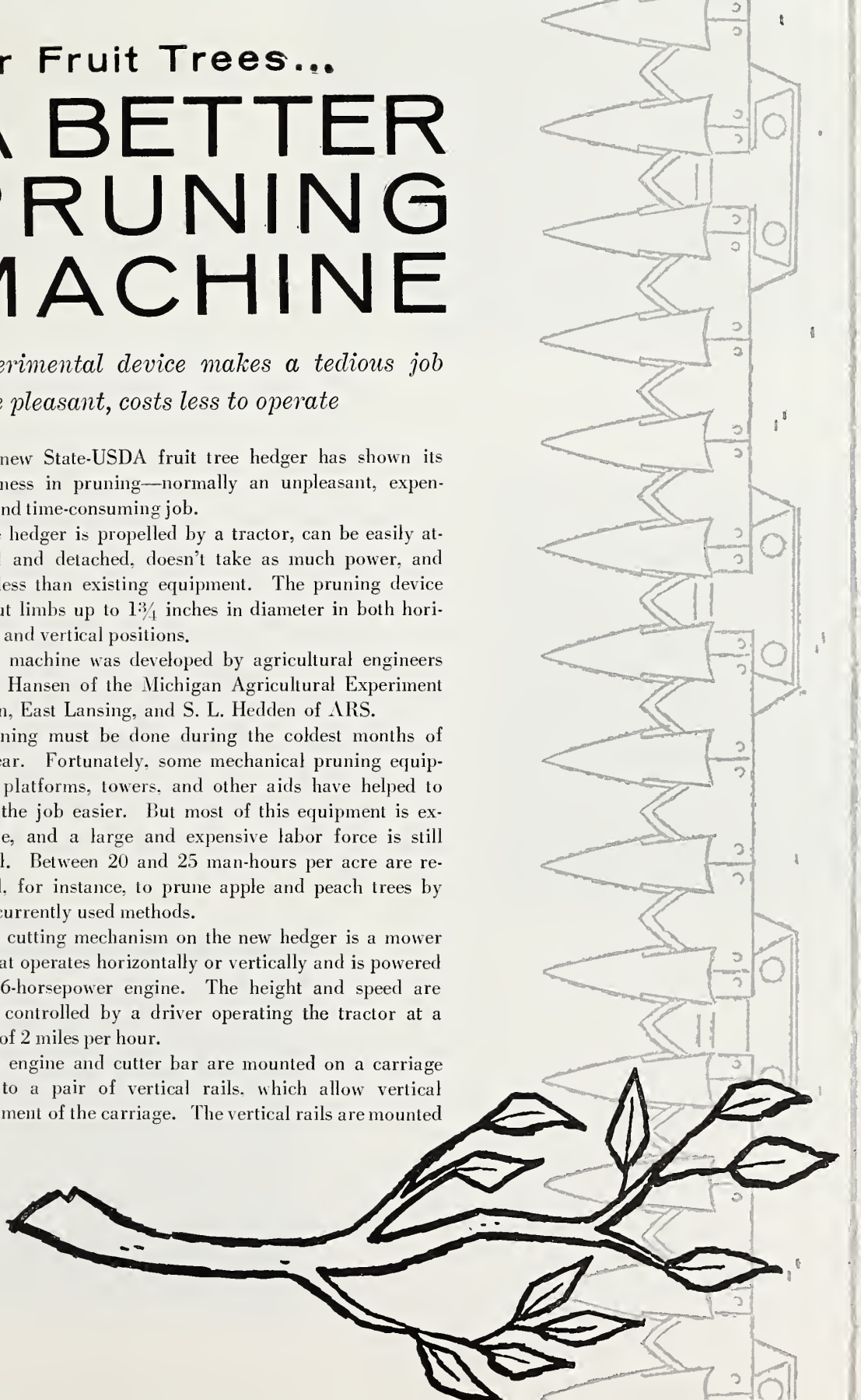
The hedger is propelled by a tractor, can be easily attached and detached, doesn't take as much power, and costs less than existing equipment. The pruning device will cut limbs up to 1¾ inches in diameter in both horizontal and vertical positions.

The machine was developed by agricultural engineers C. M. Hansen of the Michigan Agricultural Experiment Station, East Lansing, and S. L. Hedden of ARS.

Pruning must be done during the coldest months of the year. Fortunately, some mechanical pruning equipment, platforms, towers, and other aids have helped to make the job easier. But most of this equipment is expensive, and a large and expensive labor force is still needed. Between 20 and 25 man-hours per acre are required, for instance, to prune apple and peach trees by these currently used methods.

The cutting mechanism on the new hedger is a mower bar that operates horizontally or vertically and is powered by a 6-horsepower engine. The height and speed are easily controlled by a driver operating the tractor at a speed of 2 miles per hour.

The engine and cutter bar are mounted on a carriage fitted to a pair of vertical rails, which allow vertical adjustment of the carriage. The vertical rails are mounted



Fruit tree hedger, attached to a tractor, in operating position for trimming the tops of the trees.

Mower bar shifted to vertical position for trimming sides of trees. Height and speed are controlled by tractor driver.

A BETTER PRUNING MACHINE

(Continued)

on a two-wheel, rubber-tired trailer. A motor powered by the tractor's hydraulic system drives a cable winch, which is used to control the carriage height. This motor is operated from the tractor.

The cutter bar is so adjusted that it will reach the limbs in the top center of large trees that can't be trimmed with a single pass on each side. Distance of the trailer tongue (movement of which permits adjustment of the cutter bar) from the tree can be used by the operator to gauge the amount that will be trimmed from the sides of the tree. This is useful when the cutter bar is in a vertical position and the tractor is driven down the center of the row.

The engine and cutter bar carriage is adjustable from a height of 7 to 14 feet. The top section of the rails folds down to make an overall machine height of 7½ feet for transporting and storage. A canvas sheet is attached to the trailing edge of the cutter bar to carry the prunings out of the tree to the ground.

Work will be continued to compare the hedging machine with power- and hand-pruning equipment on a cost and production basis. More information is needed on maximum ground speed and sickle bar speed. Some time will be needed to determine any difference in fruit yield. The possibility of improved spray coverage in hedged trees will also be studied. And, finally, the extent to which additional pruning is needed will be determined. ☆

Cutting mechanism on fruit tree hedger severed limbs up to 1¾ inches thick, in horizontal, vertical positions.

Production records give fastest, most accurate answer when dairymen ask

How much Milk will she Produce?

■ Using production records to select dairy breeding stock is the fastest way to build high-producing, money-making herds. Dairy type or physical appearance is valuable chiefly in eliminating obvious abnormalities.

These conclusions come from a USDA study of research results obtained in the past quarter century. They show a need for more emphasis on production records and less on the traditional score card classification.

The study included analyses of data on Holstein-Friesian, Jersey, and Ayrshire cattle reported by agricultural experiment station workers in Wisconsin, West Virginia, Iowa, Illinois, and Canada. It is part of a larger study, now nearing completion, by ARS dairy husbandman N. D. Bayley and associates to determine the influence of type on milk production, longevity (AGR. RES., Jan. 1960, p. 14), and merchandising value.

The scientists found only a slight relationship between dairy-type score (*Excellent, Very Good, Good Plus, Good, Fair*) and production ability. Many cows with high dairy-type classifications are high producers at least partly because they get better feed and care. This tends to exaggerate type-production relationships, especially when evaluations are based on production averages for cows in different herds.

Slight relationship shown by record check

For example, Holstein records showed a difference in average butterfat yield of 11.4 percent between all cows rated *Excellent* and those rated *Good Plus*. But a Wisconsin analysis of records of 45,000 Holstein cows showed a difference of only 6.7 percent between the *Excellent* and *Good Plus* cows in the same herd. The lower percentage ruled out feed and management differences and more nearly reflects the true *and low* relationship between type score and production.

The analysis also showed that production cannot be predicted on the basis of type rating. On the average, prediction of butterfat misses actual production by as much as 69 pounds. This error is greater than the entire difference of 60 pounds between the lowest (*Fair*) and the highest (*Excellent*) type cows in the herds studied by Wisconsin workers.

Of the components that make up a type score, dairy character appears most closely associated with production. Bayley estimates that selection on dairy character alone is about four times as effective in raising milk yield as is selection on total type score. Progress is still less than half as fast, however, as it is when selection is based on single lactation records. Used with production records, dairy character increases breeding progress by 2 or 3 percent, compared with only 0.4 of 1 percent when total type score is used.

Dairy character is difficult to describe

A serious drawback to dairy character as a selection tool is difficulty in describing it exactly. Many judges consider dairy character as "general appearance for milkiness," but their interpretations vary widely. The scientists found greater variation in scores for dairy character than for any other type component.

Some traits associated with a heavy milker—thin, angular body and full, distended udder—may be the result rather than cause of high production. Also, well fed animals tend to show less of these traits than poorly fed animals with similar yielding ability. However, since dairy character does have some use in estimating production of lactating cows without records, an objective definition is urgently needed.

What do these research findings mean to commercial dairymen? Bayley sums up like this: Dairymen with average- or low-yielding herds should concentrate on better management and selection on the basis of production records. Those who have built highly productive herds, through good management and selection based on production records, should recognize that if they now desire to select for improved type, they must go slower in increasing milk and butterfat production.

Bayley believes that when dairymen become more aware of the slight relationship between type and production, they will give much less importance to type. ☆

A new test uses lymph node extracts to aid in diagnosis—giving us an advantage if the disease does infect our cattle

WE'RE LEARNING MORE ABOUT RINDERPEST

■ We can thankfully number rinderpest among the livestock diseases we *don't* have in our country and that's the way livestockmen and researchers would like to keep it. To protect our cattle against the devastating effects of this highly dangerous, contagious, and fatal disease should it ever get a foothold here, though, USDA is conducting research on diagnosis and handling methods.

Only recently, studies at the ARS Plum Island Animal Disease Laboratory, Greenport, Long Island, N.Y., have given us a serological test to diagnose rinderpest, using lymph node extracts from infected cattle as antigen. (Plum Island is our outpost for all research on contagious, foreign livestock diseases.)

Rinderpest can presently be diagnosed in several ways. One method is to inoculate tissue from suspected animals into susceptible and immune cattle and watch for symptoms of the disease. Obviously, this is a time-consuming process.

Another method is by complement-fixation. This widely used test involves reactions with an antigen (from diseased tissue) from the suspected animal, antibodies from the serum of an immune animal, a complement, and indicator. The resulting cell behavior generally indicates whether or not the disease organisms are present. But currently used complement-fixation tests require prolonged preparation of tissues before they can be used as antigens.

Other diseases hinder diagnosis

To further complicate matters, diagnosis is hampered by less serious rinderpest-like diseases—mucosal disease, virus diarrhea, malignant catarrhal fever, papular stomatitis, and nonspecific erosive stomatitis. And yet, a fast and accurate diagnosis is essential because of the fast spread and high death rate associated with the disease.

Chemist S. S. Stone and veterinarian W. W. Moulton collected mesenteric, mandibular, and prescapular lymph nodes 4 to 10 days after infection and up to 12 hours after death. Antigen was extracted from nodes by high speed homogenization and differential centrifugation.

The reaction was complete in an hour, using fixed concentrations of both antigen and antibodies and varying dilutions of the complement. No such reaction was obtained in a control test with normal rabbit serum or noninfected bovine tissue.

Another method, using varying amounts of antigen and antibodies and fixed concentrations of complement, gave similar results.

Virus destroys lymphoid tissue

Mesenteric lymph nodes were best as an antigen source at the height of the fever—3 to 6 days after onset of infection. Large amounts of antigen were necessary.

Rinderpest virus has an extremely destructive effect on lymphoid tissue (and epithelium of the gastrointestinal tract). This probably accounts for the high content of antigen in the mandibular and mesenteric nodes, which drain areas of virus activity. Not as much antigen is found in the prescapular nodes, which don't drain areas of virus activity.

The fairly fast and gentle treatment of nodes during extraction by this procedure prevents a large loss of antigen since the rinderpest virus is susceptible to variations in pH, temperature, and dehydration. Freezing and storage of the antigen didn't alter its ability to act in the complement-fixation test.

Similar results were obtained on three common strains of rinderpest—Pendik, Pak Chong, and Kabete.

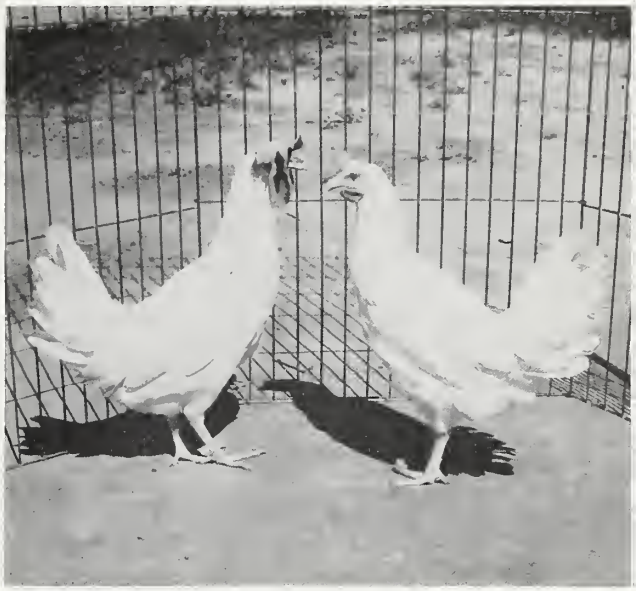
Rinderpest has appeared at various times on all continents of the Eastern Hemisphere but is now restricted to Africa and Asia. Modern air travel has pretty effectively cut down on the ocean barrier. Shipments of cattle from infected areas into this country are prohibited. Inspection and quarantine measures are enforced by the Department on the entry of other animals and animal products to preclude possible introduction of this disease. Should it ever occur here, we would conduct a vigorous campaign involving not only inspection and quarantine but also slaughter of infected and exposed animals and cleaning and disinfection.

Rinderpest-affected cattle show distinctive symptoms. Sick animals develop a high fever and profuse diarrhea, and they become gaunt, emaciated, and dehydrated. Ulcerations appear in the mouth and nostrils. Hemorrhages and shallow erosions are found in the true stomach (or abomasum) and intestines. The heart and gall bladder may also show hemorrhages. Affected animals usually die in a week but the more resistant ones may linger 2 to 3 weeks and often develop pneumonia. Mortality is usually 90 percent or more.

Believe virus is not hardy

There's a brighter side to the picture. Although little is known regarding persistence of the virus, it's thought that the virus isn't hardy and infection can be obtained only by direct contact with the infectious secretions and excretions.

Also, immunization methods have been developed and are effective in some parts of the world. But the virus strains differ greatly in virulence and different breeds vary in susceptibility to the disease. Thus, immunization methods must be adapted to the area and breed. ☆



Hen at left with a good comb had just enough light; hen at right with poor comb, too much.

HENS CAN GET

Too much Light too Soon

■ Poultrymen have used artificial light for years to make hens lay more eggs. But there's a limit to the amount of light you can give them and how soon after birth you can give it to them.

USDA tests showed, for instance, that birds getting too much light at too young an age come into production later and are inferior in general body and feather development than birds getting just the right amount. The work was done by ARS poultry husbandman R. W. Lowe at the Southwest Poultry Experiment Station, Glendale, Ariz.

One group of White Leghorns got 16 hours of light daily from birth to 14 weeks, then 8 hours daily to 20 weeks. Another group got only 8 hours of daily light to 14 weeks, then 16 hours daily to 20 weeks.

Birds in the latter group started laying the 17th week and were laying at about 15 percent of ultimate capacity at 20 weeks. Chickens in the first group had smaller combs, coarser feathers, and were generally retarded sexually. They didn't start laying until 21 weeks.

In earlier tests at the station, Lowe exposed a group of 200 birds to 10½ hours (normally used) of daylight from birth to 20 weeks. Another group was exposed to 16 hours of light up to 20 weeks. Then both groups were placed on 14 hours of daily light.

The birds that received 10½ hours of daylight matured about 10 days earlier and laid more eggs, averaging about 4 to 5 eggs each more than chickens in the other group. ☆

Difference in height between corn row at right and its parent row at left is due to mutation. Both rows came from selfed doubled monoploid corn.

Leaves and tassels also showed mutations. Narrower leaf is mutation from normal-width leaf beside it; tassel with few branches, from the normal many-branched form.

GENETIC VARIABILITY, INDICATED BY A HIGH MUTATION RATE, OFFERS . . .

New Opportunities to Improve Corn Plants

■ An estimate of the mutation rate of genes controlling *quantitative* characteristics in corn—traits such as yield and height that show a wide variability from plant to plant—has been obtained by USDA and State scientists in a unique study.

The high rate of gene mutation found in the research suggests that the opportunities for improvement of quantitative traits in corn plants may be greater than previously thought.

Agronomists G. F. Sprague and L. H. Penny of ARS and W. A. Russell of the Iowa Agricultural Experiment Station made the study. It is the first attempt to measure mutation rates of quantitative plant characterisics. Mutation rates for *qualitative* traits of plants and animals, e.g., kernel color in corn, albinism in humans, have been established by many researchers.

Plants are not readily separated into distinct classes on the basis of quantitative traits as they may be by qualitative traits. For example, plants of different heights will result from a cross between a comparatively short plant and a tall plant. Classification as either short or tall of the plants ranging in the middle would be completely arbitrary. But in a cross segregating for white or yellow kernel color, the resulting plants may be distinguished from one another as producing *either* white or yellow kernels.

Quantitative traits are controlled by many pairs of genes; the precise number and effect of the individual genes are unknown. For this reason, the estimated mutation rate—4.5 mutations *per trait* per 100 sex cells—is a composite rate for all the genes controlling a particular trait. Since a qualitative characteristic may be controlled

by one pair of genes (in some cases, more than one pair is involved), the mutation rate is figured on a per gene basis. One mutation *per gene* per 100,000 sex cells is considered average. Although the two rates are not directly comparable, the estimate for quantitative traits implies a very high degree of genetic variability in quantitative characteristics.

Such variability has previously been attributed to the fact that many genes are involved in quantitative inheritance and to the influence of environment on quantitative traits. The researchers feel, however, that a high mutation rate provides a more adequate explanation for the degree of variability observed in height, yield, seed weight, ear length, and other quantitative traits in open-pollinated corn.

Progeny of rare corn made study possible

Genetic material which made the study possible was doubled monoploid corn. Doubled monoploids are the progeny of rare corn plants with only one set of gene-bearing chromosomes (monoploids or haploids). The even rarer seed produced by monoploids has the usual two sets of chromosomes carried by corn plants, with the important difference that the sets carry identical genes.

Thus, although the number and exact influence of the genes involved in each quantitative trait was unknown, any significant change which occurred in these traits in progenies grown from the doubled monoploids could be attributed to gene mutation. Such changes, however, were identified as mutations only when they were transmitted to future generations of plants.

The doubled monoploids were grown and allowed to self fertilize for 6 generations. Seeds from the S_2 (third selfed) through S_6 generations were placed in cold storage. Plants of these generations were then grown from the stored seed at the same time so that all measurements and observations could be made under the same environmental conditions. This minimized as much as possible confusion of environmental effects with actual genetic changes taking place.

Eleven groups of doubled monoploids, originating from different inbred and synthetic lines of corn, were used in the experiment. Mutations were observed in each of eight characteristics measured: plant height, leaf width, ear length, ear diameter, weight per 100 kernels, weight of shelled grain per plant, and number of kernel rows and tassel branches. Two groups showed mutations in all eight traits. The other nine groups showed mutations in at least two of the traits.

For example, the mean ear length in one group of plants changed from 127.9 millimeters in the S_3 generation to 141.2 mm. in the S_4 generation, and this change was passed on to the S_5 and S_6 generations.

Reverse mutations, reduction instead of enlargement, were also found. In another group, the mean weight of shelled grain changed from 51.3 and 51.9 grams in the S_3 and S_4 generations, respectively, to 45.0 in the S_5 generation and 43.8 in the S_6 generation.

Plan research using long-time inbred corn

A similar study is planned using long-time inbred corn rather than doubled monoploid plants to evaluate the possibility of the observed high mutation rate being caused by the monoploid condition.

What does this high mutation rate imply for future corn improvement? If the degree of genetic variability indicated by the high mutation rate is general, a greater control over genetic inheritance may bring about even greater improvements in quantitative characteristics than have been made or envisioned up to now.

For instance, according to the dominance theory of inheritance, a characteristic is in its best possible form when one or both genes of a pair which control it are dominant. According to the over-dominance theory of inheritance, the best possible form is reached only when two unlike genes—a dominant and a recessive—make up each pair which controls the trait.

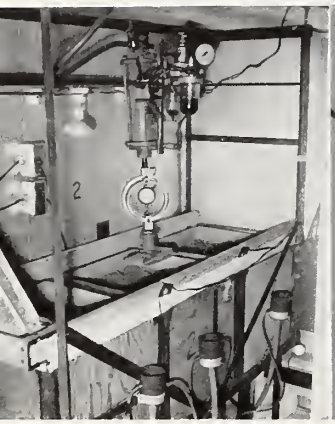
A high mutation rate suggests that quantitative traits of corn are probably controlled by a highly varied mixture of gene pairs—some dominant, some recessive, and some dominant-recessive. So there's a long way to go to approach the ideal. ☆

Sprague bags tassel, one step in self pollination, in further experiments on doubled monoploids.

PLANTING FOR MAXIMUM

Seedling Emergence

Soil firmed at seed depth, not on the surface, seems most efficient



This device was used to firm soil at seed level and on the surface.

Many corn, sugarbeet, bean seedlings (from left) didn't emerge if 10 p.s.i. pressure was used on soil surface.

■ Sugarbeet, corn, bean—and possibly other seedlings—may emerge better if planters are designed so seeds are pressed into firmed soil and covered with loose earth, Michigan-USDA experiments indicate.

Usual field practice is to place such seeds in loose soil that is then pressed on the surface with special wheels on the planter. This procedure not only forms a soil layer which may be difficult for seedlings to penetrate, but also restricts the oxygen supply and encourages surface crusting after rain. Thus, pressing the soil surface may greatly decrease seedling emergence.

The experiments show that firming the soil at seed level promotes maximum seedling emergence by ensuring moisture transfer (through capillary action) from below. A loose soil covering (1 inch was used in the tests) aids by minimizing surface crusting and allowing oxygen to circulate freely. These studies also indicate that firming the soil, on the surface or at seed level, is of no benefit unless there is adequate moisture available *below* the seed.

This is the report of agricultural engineers B. A. Stout and W. F. Buchele of the Michigan Agricultural Experiment Station and ARS plant physiologist F. W. Snyder.

Field conditions were simulated by placing in boxes an 8-inch layer of undisturbed Sims subsoil, obtained during the winter when the ground was frozen. The subsoil was covered with 8 inches of tilled top soil (Sims sandy clay loam). Water was added through gravel under the subsoil. Heat lamps maintained a 60-degree temperature above the soil surface. Air, drawn across the soil surface, simulated a 5-mile-per-hour wind. Bean, corn, and sugarbeet seeds were planted 1 inch deep after treatment with a fungicide.

Comparisons were made of seedling emergence from soil firmed at seed level, using pressures of ½, 5, and 10 pounds per square inch (p.s.i.). The most rapid and highest percentage—about 90 to nearly 100 in 15 days—occurred in soil that received a pressure of 10 p.s.i. Emergence was intermediate from soil firmed by 5 p.s.i. pressure and poorest when only ½ p.s.i. pressure was applied.

Soil was firmed at two levels

In another test, soil was firmed at seed level, using 5 p.s.i. pressure, then also firmed on the surface by pressures of ½, 5, and 10 p.s.i. If a pressure of 5 p.s.i. was applied at seed level, surface pressures greater than ½ p.s.i did not improve emergence and actually depressed emergence of corn and sugarbeets.

When soil was pressed on the surface and moisture was adequate, the most rapid and best emergence (80 percent in 9 to 11 days) resulted after use of ½ p.s.i. pressure, while pressures of 5 or 10 p.s.i. suppressed emergence. This may have been due to poor aeration, inability of the seedlings to penetrate compacted soil, or a combination of these.

Test emphasizes moisture need

Surface pressures up to 10 p.s.i didn't improve emergence when there was no moisture below seed level and the supply above was near the minimum required. But with capillary moisture available below the seed, a surface pressure of 10 p.s.i. induced faster emergence than a pressure of ½ p.s.i. Final emergence, in 19 to 20 days, was about the same no matter which pressure was applied. ☆

Nutrition study shows that in addition to minerals and water

WITCHWEED TAKES ITS FOOD FROM HOST

■ Witchweed, the parasitic plant which attaches itself to the roots of corn, sugarcane, sorghum, and other grasses, may be more dependent on its hosts than believed, according to USDA-State scientists.

Food materials were shown to be transported from host plants to mature witchweed plants in cooperative experiments at the North Carolina Agricultural Experiment Station, Raleigh. It had previously been thought that witchweed obtained only water and minerals from its host once the stem of the parasite appeared above ground and chlorophyll developed.

ARS plant pathologist R. R. Nelson and W. E. Rogers, former University of North Carolina graduate student, cooperated in the nutrition study as part of efforts to learn more about the effect of witchweed (*Striga asiatica*) on host plants.

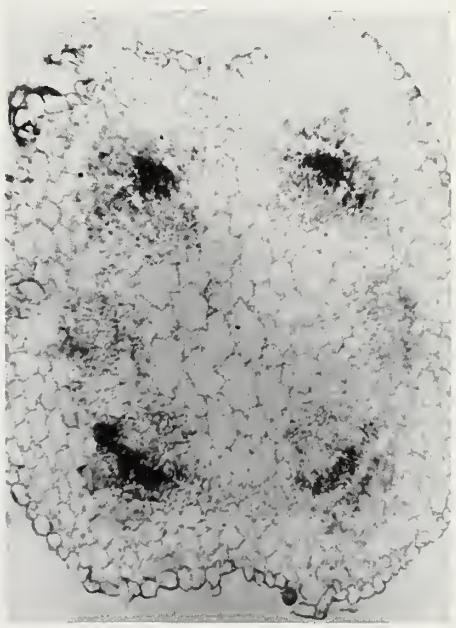
Translocation of food materials from corn plants to witchweed was traced by supplying radioactive carbon and minerals to the corn plants. The carbon, which is incorporated in food produced by photosynthesis, was detected in the parasite 48 hours after exposure of the corn plant to the radioactive element. The amount of carbon detected increased rapidly up to 72 hours later, the scientists found.

Another experiment indicated that witchweed is able to subsist entirely on its host. The parasite was grown in total darkness, thus preventing development of chlorophyll and manufacture of food by photosynthesis. The host plant, corn, was grown under normal greenhouse conditions. Except for lack of chlorophyll and a twisting of the stem, the witchweed plants became well developed and they flowered and set seed.

Nelson and Rogers also found that phloem (food-transporting) cells are present in the root of witchweed. Moreover, tests showed that cells in the haustorium (the part of the parasite's root that penetrates the host's root) have some of the characteristics of phloem cells. Thus a direct pathway appears to exist for movement of food from the phloem of the host's root into the parasite. It had previously been believed that only xylem cells, which carry water and minerals, were present in the haustorium and root of witchweed. ☆

Roots of one corn plant may be parasitized by many witchweed plants (small, dark stems above).

Cross section of corn root shows haustorium of witchweed has penetrated food-conducting cells.



Radioactive carbon supplied to corn shows up in stem of mature witchweed plant (dark spots in autoradiogram).

Placing seedcane 2 inches above furrow bottom gave best results in studies.

DEEPER PLANTING BOOSTS SUGARCANE YIELD

■ Yields of sugarcane planted in August were increased nearly 6 tons an acre by placing seedcane deeper than usual, USDA scientists report.

Such planting was superior to October planting because plants germinated better and faster, grew more rapidly, were more mature at harvest in the plant cane year, and yielded more sugar per ton of cane the first year. Weed growth was reduced because of the shading effect of foliage developed early.

This 5-year study was conducted by ARS agronomists L. P. Hebert and R. J. Matherne at the U.S. Sugarcane Field Station, Houma, La. Most growers usually plant some sugarcane in August.

Deep placement of seed pieces in August, the researchers say, also protects the young plants against early fall freezes and possible damage by cultivating implements. In addition, they point out, planting labor is more readily available in August than during the fall when harvests are underway.

Before planting, the soil is ridged to provide adequate drainage. Placement depths are measured from the bottom of the furrow formed when the soil is ridged, and seedcane is placed in the ridge. Placement of seedcane 2 inches above the bottom of the furrow gave best results in the experiments. (The usual depth is 6 to 7 inches above the bottom of the furrow.)

Seed pieces are covered with only 2 to 3 inches of soil. A thicker covering slows germination. In the fall, the furrow is filled to protect seed pieces from cold. This extra covering must be removed the following spring, or poor stands will result because soil compaction may prevent or delay germination.

August planting has some disadvantages. Cane for seed is considerably shorter than it would be in October, so a greater acreage of the crop is needed for planting. Summer-planted cane tends to harbor more cane borers than October-planted cane. Stands sometimes fail when an unusually early freeze occurs before young plants develop root systems and enough stem growth with adequate stored food for use in winter. Cane is more susceptible to cold injury at this time because the seed piece has used all of its food reserve. ☆

SOIL TEMPERATURE GUIDES COTTON GROWERS

■ Cotton farmers have their first reliable planting guide as a result of recent soil temperature studies. Cotton seedlings emerge earlier and grow faster and more vigorously if planting is delayed until minimum temperatures 8 inches below the soil surface average between 60° and 70° F. for 10 days.

Plants appeared in 5 to 9 days instead of the 2 weeks required when temperatures were below 60° in USDA tests at Lubbock, Tex. In addition, the chances of obtaining a good stand doubled. No decline in fiber quality accompanied the accelerated growth if seeds were in the ground before May 30, report agricultural engineers E. R. Holekamp and E. B. Hudspeth and agronomist L. L. Ray of ARS.

The experiment station at Lubbock serves the Texas High Plains cotton-growing area and similar work now underway in the Mississippi Delta area could guide farmers there. Experiment stations in each cotton-growing area utilizing these research findings would have to keep their own temperature records.

Cottonseed is planted only 1 to 2 inches below the soil surface but the workers found the 8-inch-depth tem-

perature more accurate in figuring the average. At a depth of 8 inches, temperatures are less erratic than they are nearer the surface, yet fluctuate enough to indicate conditions at planting level.

The average planting date for the High Plains area was May 3, determined by soil temperature measurements. However, during the test period, 1952 through 1958, the date varied from April 23 to May 16.

Cotton must be planted on the Texas High Plains as soon as the danger of frost is past because of the short growing season—the mean frost-free period at Lubbock is 205 days and cotton needs 200 warm days in which to grow. But if seeds are in the ground too early, a poor stand will result. The ideal date for planting varies from year to year.

Scientists recorded soil temperatures at depths of 2, 4, 6, and 8 inches from early April to the end of May during the first 3 years of their tests. Finding temperatures at the other three depths comparatively unreliable, they measured only at 8 inches in 1955 through 1958.

Plantings were made every 7 to 10 days, using three strains of cotton: Stormmaster, CA 119, and Paymaster 101. Chemically delinted, mechanically delinted, and untreated seed were all utilized in the experiments. ☆

AN EFFICIENT TRACTOR-SPRAYER FOR

Weed Control in Forage Nurseries

■ Here's a practical and effective method scientists can use to control weeds in experimental legumes grown in rows (space-planted) at forage nurseries.

A tractor-sprayer is fitted with metal and canvas shields to protect legumes from herbicides sprayed between individual plants and rows spaced 3 feet apart. Such spraying provided excellent control of several weeds infesting birdsfoot trefoil in a forage nursery at Ithaca, N.Y. Ragweed, lambsquarter, narrowleaf plantain, smartweed, mouse-ear-chickweed, quack grass, and yellow foxtail were among these plant pests.

Minimum crop injury resulted after spraying of a mixture of ¾ pound of 2,4–D, 6 pounds of dalapon, and 30 gallons of water per acre. (Spraying pressure was 40 pounds per square inch.) And hoeing labor was cut more than two-thirds. There was very little emergence or growth of weed seedlings after treatments.

However, certain legumes are very sensitive to injury from dalapon and some other herbicides. So the weeding method should first be tried on only a limited scale if the tolerance level of the legume is not known.

New procedure is considered superior

Geneticist R. R. Seaney and agronomist M. M. Schreiber of USDA, who developed and tested the spraying equipment, consider the weeding procedure greatly superior to mechanical cultivation or hand-hoeing. The ARS scientists worked in cooperation with the Cornell University Agricultural Experiment Station.

Only 4.5 man-days were required to control weeds in a 2-acre nursery during the 1959 season. (This includes time for spraying and later hoeing of weeds very close to trefoil.) From 12 to 15 man-days would be needed to control the weeds by cultivating and hoeing.

Cultivators usually injure space-planted legumes by cutting too close to plant crowns or by throwing soil up around plants. Hand-hoeing of test plots—often several acres—is expensive and laborious. In addition, spring cultivation is sometimes delayed by excess rain, which encourages weeds to grow rapidly. These disadvantages make early evaluation of individual legume plants very difficult or impossible.

The spraying technique can also be adapted for controlling various weeds in many low-growing row crops and grasses in nurseries, according to Seaney and Schreiber. And several herbicides may be applied at different rates to fit specific needs. ☆

Machine reduces weeding time and canvas and metal shields protect the space-planted legume plants from serious injury when herbicides are applied.

Death of food passages linked to

PEAR DECLINE

An infectious agent may cause impaired movement of carbohydrates, thus killing the tree roots

A mysterious decline of pear trees in the Northwest is being linked to death of sieve tubes or food passageways in rootstocks just below the bud union. This keeps carbohydrates from being translocated to the roots. They die and trees decline.

Long-range State-USDA studies in Washington, California, and Oregon also revealed that trees on Oriental rootstocks were highly susceptible to decline, those on French seedlings moderately resistant, and those on Bartlett seedlings rarely affected.

Pear-growing areas have suffered substantial losses due to decline. In north-central Washington alone, pear production dropped about 30 percent in the past 4 years.

Pear decline has been attributed to many factors. But studies show it's due to some toxic factor that causes degeneration of the sieve tubes in the bark of rootstock just below the bud union. The fact that the disorder appears to spread in previously healthy orchards shows that it's caused by an infectious agent.

Decline may be slow or rapid

Decline develops slowly over several years or rapidly in a few days. Trees with slow decline gradually lose vigor, yield less, then die. In advanced stages, little or no terminal growth is made. Leaves are small, sparse, and pale green. In late summer, some trees may suddenly wilt and die. This condition—quick decline—is more prevalent on vigorous trees that show no previous symptoms.

There are no symptoms specific enough for positive diagnosis. In studying the pattern and distribution of pear decline in Northwestern orchards, however, scientists noted degenerating sieve tubes just below the bud graft in bark samples from declining trees. Studies confirmed the close association of decline to pathological changes in sieve tubes.

Conducting the studies were plant physiologist L. P. Batjer of ARS and the Washington Agricultural Experiment Stations, and plant pathologist Henry Schneider of the California Agricultural Experiment Station.

Bartlett reaction surprising

The fact that trees on Bartlett roots are so unaffected by decline, compared to trees on French seedling stock, is surprising because both are of the same species. But imported French seedlings come from many parent varieties and are genetically highly heterogeneous. Bartlett seedlings come from more uniform stock.

The lower starch content in roots of trees with pear decline was more evidence that carbohydrate translocation was impaired due to death of sieve tubes in rootstocks just below the bud union. Finding more starch in bark just *above* the bud union than in bark higher up indicates piling up of starch—further evidence that sieve tubes weren't functioning.

Bud union symptoms in trees with decline apparently result from a series of changes started by an infectious agent. Some substance toxic to rootstock sieve tubes—but not to scion sieve tubes—moves across the bud union in the translocation stream. This toxic material causes death of some sieve tubes and a thickening of the walls of those not killed.

Death of the rootstock sieve tubes stimulates the cambium to produce normal or highly abnormal replacement tissue. Sieve tubes may function briefly in this tissue. Sometimes the tissue has a brown discoloration (valuable in diagnosis). On slow-decline-affected trees, abnormal replacement tissue may form yearly, producing swellings on the inner surface of the bark of rootstock below the bud union.

Studies show that Bartlett seedlings are satisfactory rootstocks. Where Bartlett trees on susceptible rootstocks have rooted *above* the graft union, they are free of the disorder. So, if pears can be grown on their own roots or on nonsensitive rootstocks, decline may be avoided. Unfortunately, Bartlett scions don't root readily. But possibilities of getting young Bartlett trees on their own roots are being studied. ☆

Wilted Bartlett pear tree, 30 years old, has quick decline. Diseased tree dies rapidly.

Pals succeeds Miller

C. H. Pals, a USDA veterinary meat inspector since 1932, on September 1 succeeded A. R. Miller, who retired as director of the Meat Inspection Division of ARS.

Director Pals administers all Federal inspection of meat and meat products except poultry.

His career with the Department began as an inspector in the Chicago stockyards. He then had various positions in Iowa and New York before coming to Washington in 1944 as assistant to the chief of the Federal Meat Inspection Service.

Miller served in USDA for almost 35 years and as head of meat inspection for 16. He also began as a veterinary meat inspector. in Chicago, then in New Jersey, New York City, and South Kortright. N.Y.

Both men received USDA Superior Service Awards, Miller in 1948 and Pals in 1955.

More studies of screwworm

Research aimed at finding out more about rearing and irradiating screwworm flies is planned at Kerrville, Tex., by USDA.

Kerrville is the site of much basic research that led to eradication of screwworms in the Southeast.

New irradiation methods will be studied in attempts to find one for

sterilizing male screwworms with minimum effect on their life processes. ARS researchers will also investigate nutritional needs of screwworm larvae in efforts to develop a better growing medium for them. In addition, scientists will try to develop materials to attract the flies to traps used to determine the extent and density of populations.

Workers will explore the possibility of developing special genetic strains of screwworms through irradiation. primarily to enable scientists to distinguish between laboratory-produced flies and wild ones.

Steepest slopes lose most

In one year, more than 300 tons of soil per acre eroded from bare roadbanks under study by USDA researchers at Cartersville, Ga.

Studies by ARS agricultural engineer E. G. Diseker and soil scientist E. C. Richardson, in cooperation with other agencies, showed losses of 40 to 328 tons per acre in 1959. Top losses were more than three times those recorded in previous years.

Soil losses increased with steepness of slope and were greatest on northwest slopes where alternate freezing and thawing occurred frequently during the winter. (Agr. Res., April 1960, p. 14.)

Idaho modified-certified

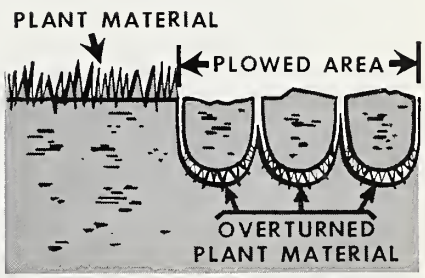
Idaho is the 25th State to be declared a modified-certified brucellosis area. Such certification means that not more than 1 percent of all the cattle or 5 percent of the herds in the State are infected with the costly disease.

With the Idaho addition, 1,976 of the Nation's 3,152 counties and all of Puerto Rico and the Virgin Islands were certified in the USDA-State campaign against brucellosis. One State, New Hampshire, has been declared brucellosis-free.

"Mat" may hinder drainage

A "mat" may be formed by plowed under cover crops or plant residues and hinder soil drainage in spring or cause drought damage to crops in summer, USDA-Missouri research indicates.

Laboratory studies show that the mat can block the capillary flow of water between surface and subsoil layers, reports ARS soil scientist V. C. Jamison. This might cause some plants to "drown" in spring from too much water and too little air in the soil. Drought damage may occur in



summer if the mat prevents capillary movement of enough moisture from subsoil to root zone above.

Further research is needed. Jamison says, to determine how farmers can eliminate or reduce effects of the mat. Present findings point to a reduction in harmful effects if furrow slices are turned on edge. This results in partial contact between the plow layer and subsoil. without any intervening vegetative layer.

Silt loam was used for the plow layer and a loessal silt for the subsoil. Shredded cornstalks were used as the mat between the soil layers.

Map for ornamentals

A "Plant Hardiness Zone Map" published by USDA will help growers in any part of the country select winter-hardy ornamentals.

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The map divides the United States and southern Canada into zones by average minimum winter temperatures. Each zone appears in a different color and differs from the next

zone by 10 degrees of temperature.

With the map are lists of representative plants for the coldest zones in which they normally survive. These lists may serve as indicators of the types of plants that will be winter hardy in a particular area.

Single copies of the Plant Hardiness Map—MP No. 814—can be obtained for 15 cents from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Ion action causes acidity

Soil acidity in humid regions is caused largely by nitrate ions acting on acid-neutralizing elements in soil—not by improper water management, USDA researchers find.

The nitrate ions are electrically charged particles containing nitrogen and oxygen. Negatively charged nitrate ions combine with positively charged ions of calcium, magnesium, and potassium to form highly soluble salts that are easily carried away by drainage water. Removal of these acid-neutralizing elements results in an excess of acid-forming substances, increasing soil acidity.

Analyses of drainage waters show that almost all acid-neutralizing elements washed away are accompanied by nitrate ions, reports ARS soil scientist W. A. Raney. Very little of other acid-forming ions, such as sulfates and chlorides, are washed away. This indicates that nitrates are the important ions in the loss of acid-neutralizing elements.

Improper water management, including excessive irrigation, is only a minor factor in soil acidity. Acid-neutralizing elements are removed by the first water draining through soil. Later drainage has little effect on soil acidity.

In soil, nitrates are the final form nitrogen takes, whether it is applied as chemical fertilizer or formed by bacterial action. Where soil nitrogen is maintained at a high level, Raney says, acidity may be expected unless lime is added to replace non-acid-forming elements that leach out—or other means are used to keep the nitrate concentration down.

Committee meetings start

USDA's 24 research and marketing advisory committees began a series of annual meetings with the Forest Research and Marketing Committee meeting October 2–7 at Paul Smiths, N.Y.

These committees, representing all segments of agriculture, help appraise its research and service programs and plan for the future.

Sixteen committees advise on particular farm commodities: rice; sheep and wool: forage, feed, and seed; citrus and subtropical fruits; potatoes; dairy products; sugar; grain: deciduous fruits and tree nuts: poultry; oilseeds and peanuts; tobacco; vegetables: livestock; cotton; and refrigerated and frozen products.

The other committees advise in more general areas such as food and nutrition, transportation, economics, and farm equipment and structures. All the groups will meet some time between October and next March for about five days each.

Makes creases long-lasting

A new chemical treatment puts creases (or pleats) in wool slacks and skirts that last through long wear and rainy or humid weather. If the fabric is suitably shrink-proofed, the creases hold through machine washing, report ARS chemists N. H. Koenig, W. L. Wasley, and C. E. Pardo.

First the fabric is sprayed with or dipped in a 0.5 to 2.0 percent solution of ethanolamine in water, with a little detergent added to facilitate wetting. Then the damp fabric is steam-pressed.

It took about a minute to set

creases in lightweight suiting, using a temperature of about 280° F. in a tailor's pressing machine.

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